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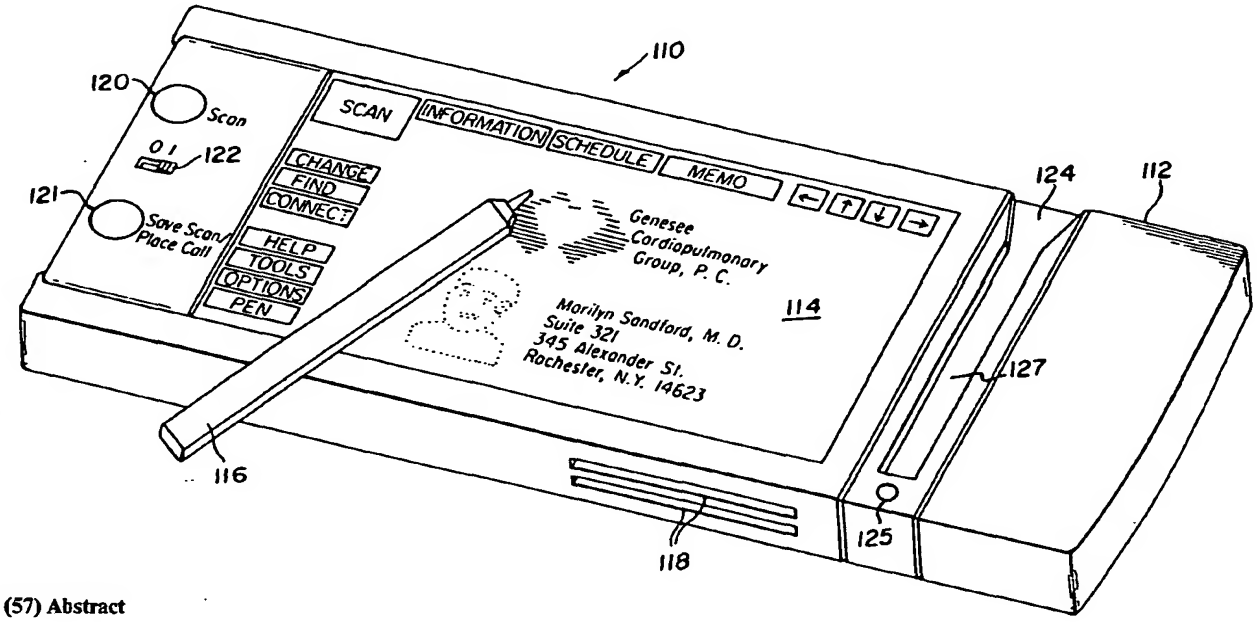

(57) Abstract

The present invention provides a cordless electronic stylus that utilizes one or more capacitors in place of conventional batteries to provide an on-board power supply. The charge storage capacity of the capacitors is chosen to permit the overall dimensions of the stylus to be smaller and more pen-like than conventional electronic stylus devices that use batteries. An electronic "ink-well" is provided to permit the rapid recharge of the capacitors. The ink-well can either be a stand-along unit or incorporated into the structure of a digitizer tablet or electronic pocket organizer.

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CORDLESS ELECTRONIC STYLUS AND ELECTRONIC INK-WELL

Technical Field of the Invention

The invention relates in general to an electronic stylus or digitizer pen that is used generate digital position information. More specifically, the invention relates to a cordless electronic stylus that is used to "write" or "draw" on an electronic display device including, for example, a liquid crystal screen or a cathode ray tube (CRT).

Background

Several different technologies have emerged to generate digital position data indicative of the movement of a stylus across an electronic display device or digitizer tablet. The digital position data is used to generate corresponding electronic graphical representations of the stylus movement on the display device. Pixels of a display screen, for example, are darkened to mark the path of the stylus as it moves across the display device giving an appearance similar to the application of ink onto a piece of paper. The above- mentioned "electronic ink" technologies are commonly used in conjunction with preprogrammed graphics that are displayed on the display device including, for example, fill-in-the-blank templates for form generation. While some electronic ink technologies are closed looped systems requiring the stylus to be tethered, the most convenient and conventional pen-like systems sense the localized pressure of the stylus on the display device or sense signals that are emitted by the stylus.

An example of an untethered or cordless stylus device of the type that emits a signal is illustrated in U.S. Patent 4,672,154, the contents of which are herein incorporated by reference. The advantages of an

untethered stylus are obvious, namely, the operator is given full freedom of movement. Signal emitting stylus devices, however, require the use of an on-board power source. Conventional stylus devices have utilized one or more storage batteries as an on-board power source, but batteries having sufficient storage capacity to permit operation of the stylus for extended periods require the size and weight of the stylus to be much larger than a conventional pen.

It is therefore an object of the present invention to provide a cordless electronic stylus of the signal emitting type that does not require the use of conventional storage batteries as a power source. The stylus of the invention is therefore lighter and more compact than conventional cordless electronic stylus devices.

Summary of the Invention

The present invention provides a cordless electronic stylus that utilizes one or more capacitors in place of conventional batteries to provide an on-board power supply. The charge storage capacity of the capacitors is chosen to permit the overall dimensions of the stylus to be smaller and more pen-like than conventional electronic stylus devices that use batteries. An electronic "ink- well" is provided to permit the rapid recharge of the capacitors.

The cordless electronic stylus includes a transmitter/oscillator circuit, a constant current source, a transmitter activation switch coupled between the transmitter/oscillator circuit and the constant current source, a power storage network, including at least one capacitor and one resistor, coupled to the constant current source, and contact electrodes coupled to the power storage network.

In a preferred embodiment, the constant current source supplies an operation voltage of 1.5 volts at one milliampere to the transmitter/oscillator circuit when the transmitter activation switch is activated, and capacitor has sufficient storage capacity to power the operation of the constant current source for approximately thirty seconds. In order to provide the desired voltage level and operating time, a resistor has having a value of 20K ohms and one or more capacitors having a capacitance of 750 microfarads and a charging voltage of 20 volts are employed in the power storage network.

The cordless electronic stylus is quickly and easily recharged by dipping the stylus into an electronic ink- well. The electronic ink-well preferably includes a recharge well and a storage slot, each of which includes contact electrodes configured to make contact with the contact electrodes of the cordless electronic stylus. The contact electrodes of the electronic ink-well are coupled to a D.C. power source. The ink-well can employed either as a stand-alone unit or integrated into the structure of a device, such as a digitizer tablet, that includes a working surface that is response to signals generated by the stylus.

The stylus and electronic ink-well are particularly well suited for use in a pocket electronic organizer of the type, for example, that includes a main unit having an integral scanning unit, a touch sensitive display unit, a memory unit, a control unit for controlling the processing and storage of text and image data entered into the main unit through the integral scanning unit and the touch sensitive display unit, and a battery unit releasably coupled to the main unit, wherein the electronic stylus is used for entering data into the organizer via the touch

sensitive display unit. The ink- well is preferably incorporated within the main unit of the organizer.

Brief Description of the Drawings

With the above as background, reference should now be made to the following detailed description and the accompanying drawings, in which:

Fig. 1 is a schematic diagram of a stylus in accordance with the present invention;

Fig. 2 is an electrical schematic diagram of the stylus illustrated in Fig. 1;

Fig. 3 is a partial sectional view of an electronic ink-well in accordance with the present invention;

Fig. 4 is a perspective view of a digitizer tablet incorporating an electronic ink-well in accordance with the present invention;

Fig. 5 is a top perspective view of an electronic organizer incorporating a stylus and electronic ink-well in accordance with the present invention;

Fig. 6 is a perspective view of the bottom of the electronic organizer shown in Fig. 5;

Fig. 7 is a schematic representation of the layout of a scanning unit in the electronic organizer illustrated in Fig. 5;

Fig. 8 is a schematic block diagram of the electrical operating system of the electronic organizer illustrated in Fig. 5;

Fig. 9 illustrates the display of information on a display unit of the electronic organizer illustrated in Fig. 5 on power up;

Fig. 10 illustrates the display of schedule information on the display unit of the electronic organizer illustrated in Fig. 5;

Fig. 11 illustrates how data can be correlated using a relational database in the organizer illustrated in Fig. 5;

Fig. 12 illustrates the display of a virtual alphanumeric keyboard on the display unit of the organizer illustrated in Fig. 5;

Fig. 13 illustrates the entry of hand-printed text information using the pen input unit of the organizer illustrated in Fig. 5;

Fig. 14 illustrates a database record file that is displayed on the display unit of the organizer illustrated in Fig. 5;

Fig. 15 illustrates the blocking of identified text fields;

Fig. 16 is a flow diagram illustrating the operation of the scanner unit and digital signal processor illustrated to scan an image; and

Fig. 17 is a flow diagram illustrating the entry of data in a Text input window 1.

Modes of Carrying Out the Invention

A schematic diagram of an cordless electronic stylus according to the present invention is shown in Fig. 1. The stylus includes a main body 10 that encloses a transmitter/oscillator circuit 12, a constant current source 14, and an RC power storage network consisting of one or more capacitors 16 and a resistor 18. A transmitter activation switch 20 is provided at the tip of the stylus and is used to connect the constant current source 14 to the transmitter/oscillator circuit 12 when the tip of the stylus is pressed against a working surface. The capacitors 16 are connected to conductive contacts 22, 24, for example metallic rings that are preferably located near the tip of the stylus and separated by an electrical insulating material, wherein a D.C.

electrical charge applied to the conductive contacts 22, 24 will cause a charge to build up in the capacitors 16.

The switch 20 is preferably a spring loaded normally-open switch that closes when the user presses the tip of the stylus against the working surface of any type of device (including a digitizer tablet, a CRT screen or a liquid crystal display) that utilizes a signal produced by the transmitter/oscillator circuit 12 to generate digital position data indicative of the locate the stylus on the working surface. As shown in greater detail in Fig. 2, power is supplied from the constant current source 14 to the transmitter circuit 12 when switch 20 is closed, thereby activating the transmitter circuit 12.

The transmitter/oscillator circuit 12, in a preferred embodiment, requires a constant 1.5 volts at one milliampere. The constant current source 14 is preferably utilized to permit the values of the capacitors 16 to be chosen so that the overall size of the stylus can remain relatively small while still providing sufficient energy reserve for a preferred thirty seconds of operation. For example, the general formula for a resistive/capacitive time constant is Tc = R * C. The value of the resistor 18 must therefore be small enough to be able to pass one milliampere of current, but large enough to allow for the capacitors 16 to be of reasonable physical size to be incorporated into the main body 10. If the capacitors 16 were to store energy at the operational voltage of the transmitter/oscillator 12, a 150 Ohm resistor and an capacitance of 0.2 Farads at 1.5 volts would be required. These values, however, are unrealistic for use in the stylus when considering the physical size of commercially available capacitors.

A solution to this problem was found by holding the voltage and current supplied to the transmitter/oscillator 12 constant and increasing the RC network charge voltage, thereby allowing a larger resistor and smaller capacitors to be utilized. For example, solving the following equation for E (charging voltage) to give thirty seconds of operation time using reasonable R and C values:

$$Vt = E\ (e^{-t/RC})$$

Where Vt = capacitor voltage (> = 1.5 Volts) at t/RC (multiples of the time constant), t = time in seconds (30) and e = the natural log constant 2.71828, the following values were obtained:

E= 20V, R = 20K Ohms and C = 750 microfarads (t/RC = 2)

Commercially available resistors and capacitors having the above values can be readily incorporated into the main body 10 of the stylus. Although the available power from the capacitors 16 is limited to about thirty seconds of normal operation, it has been determined that the thirty second period is sufficient for most operations if the capacitors can be easily and quickly recharged.

The task of recharging of the capacitors is accomplished by the provision of an electronic "ink-well" 30 (recharging station). As illustrated in Fig. 3, the ink-well 30 consists of a charging well or port 32 that matches the physical shape of the tip of the stylus where the conductive contacts 22, 24 are located. The well 32 includes conductive rings 34, 36 that make contact with the conductive contacts 22, 24 of the stylus when the tip of the stylus is inserted into the well 32. The conductive rings 34, 36 are

coupled to a D.C. power source 38, for example a storage battery or a D.C. power supply, that quickly recharges the capacitors 16 once the conductive contacts 22, 24 make contact with the conductive rings 34, 36. The user can therefore "dip" the stylus into the well 32 to quickly recharge the capacitors 16 during the writing process.

In addition to the well 32, the ink-well 30 preferable includes a storage slot 40 which is used to store the stylus for extended periods of time. The storage slot 40 also includes conductive rings 42, 44 that are coupled to the D.C. power source 38 in order to maintain the stylus in a fully charged condition. In the illustrated embodiment, the slot 40 is angled in a manner similar to conventional pen holders so that a portion of the stylus extends from the slot 40. It will be understood, however, that the slot 40 can be produced in a variety of different configurations including a horizontal slot into which the entire stylus can be inserted.

The ink-well can either be a stand-alone unit as illustrated in Fig. 3 or it can be integrated with the structure of a variety of other devices. Fig. 4, for example, illustrates a digitizer tablet, of a type described in U.S. Patent 4,672,154, that converts the signals generated by the stylus into digitized positional data. The digitizer tablet includes a writing surface including a grid of electrical conductors that are coupled to data processing circuitry 52 located within a housing 54. The ink-well 56, including a well 58 and a storage slot 60, is integrated with the structure of housing 54.

The above-described stylus and electronic ink-well is particularly well suited for use with electronic pocket organizers which use a stylus instead of a keyboard for data input. The organizer illustrated in

Fig. 5, for example, includes a main unit 110, a battery power unit 112 releasably coupled to the main unit 110, a high resolution touch sensitive electronic display panel 114 located on a top surface of the main unit 110, a stylus 116 (of the type generally illustrated in Figs. 1 and 2), memory card expansion slots 118 located in the main unit 110, scanner control start and stop buttons 120-121, and a main unit power ON/OFF switch 122. An electronic ink-well 124, including a well 125 and storage slot 127, is also incorporated in the main unit 110.

The operator interacts with the main unit 110 through the use of the stylus 116 and the touch sensitive electronic display panel 114, which generates stylus position data in response to signals generated by the stylus 116. Various overlay screens or "windows" are displayed on the display panel 114 and the operator touches the stylus 116 to the display panel 114 at specified locations to perform various functions such as data entry --including hand-printed text entry and virtual alphanumeric keyboard operations-- and organizer navigational operations -- i.e. moving from one organizer function to another-- as will be described in greater detail below.

As shown in Fig. 6, the organizer also includes an imaging window 126 for a linear electronic scanner unit incorporated within the main unit 110, a speaker unit 130 which is used to generate acoustic telephone dial tones, and external power connectors 132. Front transport wheels or rollers 134 are preferably located adjacent to the imaging window 126 of the linear electronic scanner unit and rear transport wheels 136 are provided at the opposite end of the organizer. The front and rear transport wheels 134, 136 permit the organizer to be rolled over the surface of materials to be scanned including, for example, materials having

machine generated text --i.e. printed materials such as telephone directory listings-- and images --i.e. photographs or graphics-- for direct entry into the memory of the organizer.

The front transport wheels 134 are also coupled to an encoder (not shown) that generates encoding signals corresponding to the movement of the organizer over the surface to be scanned. The encoding signals are also used by a central processing unit (CPU), located on a motherboard 148 within the main unit 110 of the organizer, to monitor the speed of the scanning operation. The central processing unit preferably generates a warning signal if the scanning speed is exceeding a predetermined limit. The warning signal can be either an audio warning signal generated by activating the speaker unit 130 and/or a visual warning signal displayed either on the display panel 114 or on a separate LED indicator provided on the main unit 110. In either case, the warning signal is preferably of a type that provides feedback to the operator to warn the operator when the scanning speed limit is being approached, for example by increasing the frequency of the audio warning signal, changing the color of the visual warning signal, or by flashing the visual warning signal at varying frequencies. The visual or audio feedback permits the operator to reduce the scanning speed before the predetermined speed limit is exceeded.

The layout of the linear electronic scanning unit within the main body 110 of the organizer is illustrated in Fig. 7. The linear electronic scanning unit includes a light source 140, a mirror 142, a lens array 144, and a linear electronic image sensor 146. In operation, the image being scanned is reflected by the mirror 142 to the lens array 144, which in turn focuses the image on the linear electronic image sensor

146. The linear electronic image sensor 146, with its associated control circuitry, converts the image to digital image data in a conventional manner. The digital image data is then supplied to a digital signal processing unit (DSP) located on the motherboard 148 in the form of a bit map.

Fig. 7 also illustrates the location of the card expansion slots 118 with respect to the motherboard 148. The card expansion slots 118 accept memory cards that can either be used to expand the system memory of the organizer or to hold special software application programs or database packages. The card expansion slots 118 are preferably configured to hold memory cards that conform to the standards established by the Personal Computer Memory Card International Association (PCMCIA), including cards conforming to the Execute-In-Place (XIP) standard, although memory cards utilizing other configurations could be utilized. Memory cards that could be employed in the invention are currently available from the Maxell Corporation of Fair Lawn, New Jersey and have memory capacities on the order of one megabyte.

A basic electrical schematic block diagram of the organizers operating system is illustrated in Fig. 8. The central processing unit (CPU) 160 (for example a F8680 processor available from Chips & Technology Corporation) and the digital signal processing unit (DSP) 162 (for example a TS350C51 processor available from Texas Instruments Corporation) mentioned above are coupled to a bus 164. System memory is provided by a one megabyte capacity random access memory (RAM) unit 166 and a two megabyte capacity read only memory (ROM) unit 168. As was mentioned above, additional memory can be provided by inserting memory cards in the card expansion slots 118 which are also coupled to the bus 164. The CPU 160 controls the overall operation of the

organizer, while the DSP 162 works in conjunction with the CPU 160 to support processing operations related to scanned data.

The organizer supports two modes of scanning operations, namely, a Text Mode of operation (default mode) which is used to scan machine generated text images and a Photo Mode of operation (user selected) which is used to scan high resolution images such as photographs or graphics. Images processed in the Text Mode of operation are converted to one bit/pixel by thresholding and the image pixels are packed eight bits per byte. The images are preferably compressed by a CCITT GIII/IV (Committee Communications Internationale de Telephone et Telegraph Group III and IV) lossless method. Text Mode images may be displayed directly on the display unit 114, or an optical character recognition algorithm (OCR) can be applied to the image to convert the text image data to computer coded text data, e.g. ASCII. Images in the Photo Mode of operation are processed by an error diffusion method wherein the images are converted to one bit/pixel by distributing the gray level error into the surrounding pixels. The pixels are packed eight bits per byte and the images are compressed using a lossey or lossless method, for example, JPEG (Joint Professional Engineering Group) algorithm. The Photo Mode of operation optimizes the quality of scanned photographic images as for display on the display unit 114.

Conventional OCR algorithms can be employed by the DSP 162 to identify text data in the Text Mode of operation. Two representative algorithms for machine-print recognition include: WORDSCAN (Tm) sold by Calera Recognitions Systems of Santa Clara, California; and OMINPAGE (Tm) sold by Caere Corporation of Los Gatos, California. A separate hand-print algorithm is used by the DSP 162 to identify characters that are

written on the display unit 114 by the stylus 116 in a write mode of operation that will be discussed in greater detail below. One representative hand-print character recognition algorithm that can be employed is incorporated in the HANDWRITER (Tm) product sold by Communications Intelligence Corporation of Menlo Park, California.

The DSP 162 is preferably powered down when not in use in order to conserve power. The DSP 162, however, does not contain power down data storage capability. All internal data required by the DSP 162, including OCR algorithms and image processing programs, must therefore be downloaded to the DSP 162 each time it is powered up to perform a processing function. The DSP 162 is configured such that the internal registers of the DSP 162 are accessed by the CPU 160 as input/output devices over the bus 164.

A real time clock 174 is also included in the operating system to provide a time base to support time of day, date, calendar and alarm functions of the organizer. The operation of the real time clock 174 is controlled by a crystal oscillator to insure accuracy and stability. The real time clock 174 remains operational when the rest of the operating system is turned off by the user.

Power is supplied to the operating system via the power management circuit 150, which is coupled to the battery power unit 112 and to an emergency rechargeable back-up battery 172, when the main unit power ON/Off switch 122 is activated. The power management circuit 150 includes a monitoring circuit that monitors the power level of the battery power unit 112 and switches to the emergency rechargeable back-up battery 172 if the monitored level falls below a predetermined value. A recharging circuit is also provided within the power management circuit 150 to recharge the back-up battery

172 either from the battery power unit 112 (once a new or recharged battery power unit 112 is installed) or from an external AC or DC source that is coupled to the power management circuit 150 via the external power connectors 132. The function performed by the power management circuit 150 is particularly important to prevent the loss of data stored in the RAM unit 166 which must be continually supplied with power. In addition, the power management circuit 150 supplies power at the appropriate voltage level to the ink-well 124.

Data entry and retrieval is primarily accomplished through the high resolution touch sensitive electronic display panel 114 in conjunction with the stylus 116. A communications module 176, however, is also coupled to the bus 164 to permit text and image data to be downloaded directly to the operating system from external sources. The communication module 176, for example, includes a standard serial and/or parallel computer interface circuit (for example a standard RS232 interface) which permits the organizer to be directly connected to a computer. A facsimile interface circuit and a modem are also preferably included within the communication module 176 to permit the organizer to receive and transmit data via telecommunication lines. To conserve space within the main unit 110, however, the facsimile interface and modem can be provided as separate accessory modules that are attached to the main unit 110 when needed.

An infrared communications link is also included in the communications module 176 to permit commands and data to be entered directly into and retrieved from the operating system of the organizer without hard-wired connections. The infrared communication link is particularly useful in providing communications between two organizers without having to provide a physical

connection the two organizers. Thus, an individual can easily and quickly download schedule information or other data directly into a co-workers organizer.

The touch sensitive electronic display panel 114, in combination with the linear electronic scanner unit 126, provides an easy to learn and use interface that permits the operator to enter and retrieve data from the organizer with a minimal amount of effort. For example, Fig. 9 illustrates one type of information display that can be presented on the display panel 114 upon power-up of the organizer in a preferred mode of operation. The illustrated information identifies the owner of the organizer by name, address, company name (with company logo displayed) and photograph.

The information displayed in Fig. 9 is entered through the use of the linear scanner unit without requiring the operator to key-in the text data. For example, all of the information is obtained simply by scanning a business card containing a photograph in the Photo Mode of operation. In such a case, the information is retained as a bit-map image file in the RAM unit 166 for later retrieval and display on the display unit 114, i.e., the resulting image displayed on the display unit would be an electronic reproduction of the original business card. Alternatively, the illustrated information can be obtained by scanning different source materials, storing the information in different files, and then linking the files together through the use of a relational database to retrieve and display the information on the display unit 114. For example, if the business card did not contain a photograph, the owner's name, address and company name could be obtained from the business card by scanning the business card with the scanner unit 126 in the Text Mode of operation. An OCR algorithm is then applied to the scanned image data by the DSP 162 to identify the

text information contained therein. The identified text information is then stored in a primary database file, for example, a text based business card file. A photograph is then scanned in the Photo Mode of operation by the scanner unit 126 and the scanned photographic image data is stored in a bit-map image file in memory. The text data is then retrieved from the business card file and combined with the photographic image data from the bit-map image file upon power-up of the organizer to generate the illustrated display.

In addition to the owner information, various function blocks are displayed on the touch panel display 114. The function blocks include main functions such as Information, Schedule and Memo, support functions such as Change, Find and Connect, and accessory functions such as Help, Tools and Options. Each of the functions are initiated by touching the function block with the stylus 116. For example, a daily schedule shown in Fig. 10 is displayed by touching the Schedule function block. The schedule display screen preferably takes on the "look and feel" of a card file. The operator can easily switch days by touching the "card" for the day to be selected.

Information related to selected data fields displayed on the schedule display screen can be retrieved through the use of the relational database simply be touching the in data field with the stylus 116. The relational database is functionally illustrated in block diagram form in Fig. 11. All of the various files including a memo file, a bitmap image file, a calendar event file, a business card file and a telephone number directory file share one or more common relational information linking fields. The preferred relational information linking fields include name, address, telephone number, subject and date. The

operator is prompted at the initiation of a scan operation to identify and attach a file tag, containing one or more of the linking fields, to the image being scanned. The file tag allows each scanned image file to be easily identified and cross-referenced in any of the organizer's modes of operation.

The entry of the file tag information, as well as any annotations that the operator may wish to enter on the scanned image, can be entered by one of two different methods. The first method involves the use of a virtual alphanumeric keyboard that is overlayed on the display unit 114 as shown in Fig. 12. The stylus 116 is then used to select the "keys" of the virtual alphanumeric keyboard to enter the required information. This method, however, requires a "hunt and peck" type approach for those individuals that are unfamiliar with a standard keyboard layout.

Fig. 13 illustrates a preferred method of entering data in a write mode of operation in which the operator can use the stylus 116 to print the information on the display unit 114. In the illustrated example, a diagram of a heart has been scanned from a textbook and displayed on the display unit 114. By activating the pen function block, a text input window is overlayed over the image of the heart. The operator then prints information in the blocks of the text input window using the pen input unit 116. The DSP 162 applies a hand-print text OCR algorithm to identify the text characters that were printed in the blocks.

Text information can also be transferred from scanned images directly into a text data file without requiring the operator to key-in the text data. Fig. 14, for example, illustrates a text information file that is displayed on the display unit 114 which contains a patient's personal information as well as information on the patient's medical insurance. The

medical insurance information for the text information file is obtained directly from the patient's scanned medical card, the image of which is illustrated in Fig. 15. The CPU 160 performs a text identification routine to a bit map of the scanned medical card to identify areas of the bit map that contain text information. A box is drawn around each of the areas that are determined to contain text information. The DSP 162 then performs an OCR text recognition algorithm to the data contained within the areas specified by the boxes to identify the text data contained within the boxes. The operator can then transfer the identified text data within selected boxes into the text information file by touching a selected box to fill in a template field that is overlayed on the display. The template field continues to prompt the user to select a box for each of the fields in the text information file.

The above-described scanning operations are further illustrated in flow diagram form in Figs. 16 and 17. Fig. 16 illustrates the operation of the scanner unit 126 and DSP 162 to scan an image. At step S1, the operator selects which type of scanning mode (either the Text Mode or the Photo mode) is to be employed. After selection of the scanning mode, instructions are displayed on the display unit 114 at step S2 to tell the operator how to perform the scanning operation. The CPU 160 then enters a wait state to wait form the activation of the start scan button by the operation at step S3. Once the start scan button is activated, the CPU 160 turns the display unit 114 off to conserve power at step S4 and then applies power to the linear scanning unit at step S5. The CPU 160 then activates the DSP 162 at step S6 and loads the DSP 62 with the appropriate OCR program based on the type of scanning mode selected by the user. Digitized image data is downloaded from the image

sensor to the DSP 162 at step S7 and the DSP 162 processes the image data and stores the result in the RAM unit 166 at step S8. The CPU 60 turns off the DSP 162 and the linear scanning unit once all the image data is processed at step S9 scan lines have been entered.

Fig. 17 illustrates the entry of data in the write mode of operation in the text input window using the pen input unit 116. At step S1, the DSP 162 is powered up and then loaded with the hand-print OCR software from the ROM unit. At step S2-S3, the DSP 62 is placed in a standby mode and the text entry window is displayed on the display unit 114. At step S4, the operator uses the pen input unit 116 to write a character in a block of the text entry window. At step S5, the DSP 62 is removed from the standby mode and a bit-map representation of the hand-print character is passed to the DSP 162 for processing. The DSP 162 applies the free-hand OCR algorithm to the bit-map representation to determine the text character represented by the bit-map representation. The identified text character is displayed above the block of the text entry window at step S6 for verification by the operator at step S7. The character is stored in memory if it has been correctly identified at step S8. If the character has not been correctly identified an error message is displayed at step S9 and the operator is required to re-enter the character.

The invention has been described with reference to certain preferred embodiments thereof. It will be understood, however, that modifications and variations are possible within the scope of the claims. For example, an indicator can be added to the stylus to indicate when a recharge is required. A light emitting diode and associated circuitry can be added to the RC network such that the diode is activated when the

voltage applied to the RC network drops below a predetermined value. A mechanical indicator can also be used in place of the light emitting diode. For example, a spring loaded colored panel could be made to appear in a window incorporated in the body of the stylus. An electromagnet, controlled by the voltage level of the RC network, would be used to pull and latch the spring loaded panel when the stylus was fully charged. Once the voltage in the RC network dropped, the electromagnet would release the latch and the spring tension would cause the colored panel to appear in the window. The shape and size of the stylus, well and storage slot, the storage capacity of the capacitors, and the specifics of the described circuitry can also be modified from those specifically shown. The conductive contacts 22, 24 can also be located at any position on the body of the stylus as long as they make contact with corresponding contacts of the electronic ink-well. Finally, the invention is applicable to any type of cordless electronic stylus technology including RF and acoustic signal emitting pens.

Industrial Utility

The invention is useful in data entry systems that generate digital positional data representative of the movement of a stylus across a working surface.

WHAT IS CLAIMED IS:

1. A cordless electronic stylus characterized by: a transmitter/oscillator circuit; a constant current source; a transmitter activation switch coupled between the transmitter/oscillator circuit and the constant current source; a power storage network, including at least one capacitor and one resistor, coupled to the constant current source; and contact electrodes coupled to the power storage network.

2. A cordless electronic stylus as claimed in claim 1, wherein the power storage network has a storage capacity sufficient to power the operation of the constant current source for at least thirty seconds.

3. A cordless electronic stylus as claimed in claim 1, wherein the constant current source supplies an operation voltage of 1.5 volts at one milliampere to the transmitter/oscillator circuit when the transmitter activation switch is activated.

4. A cordless electronic stylus as claimed in claim 1, wherein the resistor has a value of 20K ohms and the capacitor has a capacitance of 750 microfarads and a charging voltage of 20 volts.

5. A cordless electronic stylus as claimed in claim 1, further comprising an electronic ink-well for recharging the capacitor contained in the power storage network.

6. A cordless electronic stylus as claimed in claim 5, wherein the electronic ink-well includes a

recharge well and a storage slot, and wherein the recharge well and the storage slot each include contact electrodes configured to make contact with the contact electrodes of the cordless electronic stylus when the cordless electronic stylus is inserted into either the recharge well or the storage slot.

7. A cordless electronic stylus as claimed in claim 6, wherein the electronic ink-well includes a D.C. power source coupled to the contact electrodes of the recharge well and the storage slot.

8. A digitizer system characterized by: a working surface including a grid of conductors for receiving electrical signals; data processing circuitry, coupled to the grid of conductors of the working surface, for generating digital position signals in response to the electrical signals received by the grid of conductors; and a cordless electronic stylus; wherein the cordless electronic stylus includes a transmitter/oscillator circuit; a constant current source; a transmitter activation switch coupled between the transmitter/oscillator circuit and the constant current source; a power storage network, including at least one capacitor and one resistor, coupled to the constant current source; and contact electrodes coupled to the power storage network.

9. A digitizer system as claimed in claim 8, wherein the power storage network has a storage capacity sufficient to power the operation of the constant current source for at least thirty seconds.

10. A digitizer system as claimed in claim 8, wherein the constant current source supplies an operational voltage of 1.5 volts at one milliampere to

the transmitter/oscillator circuit when the transmitter activation switch is activated.

11. A digitizer system as claimed in claim 8, wherein the resistor has a value of 20K ohms and the capacitor has a capacitance of 750 microfarads and a charging voltage of 20 volts.

12. A digitizer system as claimed in claim 8, further comprising an electronic ink-well for recharging the capacitor contained in the power storage network.

13. A digitizer system as claimed in claim 12, wherein the electronic ink-well includes a recharge well and a storage slot, and wherein the recharge well and the storage slot each include contact electrodes configured to make contact with the contact electrodes of the cordless electronic stylus when the cordless electronic stylus is inserted into either the recharge well or the storage slot.

14. A cordless electronic stylus as claimed in claim 13, wherein the electronic ink-well includes a D.C. power source coupled to the contact electrodes of the recharge well and the storage slot.

15. An electronic organizer characterized by: a main unit including an integral scanning unit, a touch sensitive display unit, a memory unit, and control means for controlling the processing and storage of text and image data entered into the main unit through the integral scanning unit and the touch sensitive display unit; a battery unit releasably coupled to the main unit; and an electronic stylus for data via the touch sensitive display unit; wherein the electronic

stylus includes a transmitter/oscillator circuit; a constant current source; a transmitter activation switch coupled between the transmitter/oscillator circuit and the constant current source; a power storage network, including at least one capacitor and one resistor, coupled to the constant current source; and contact electrodes coupled to the power storage network.

16. An electronic organizer as claimed in claim 15, wherein the power storage network has a storage capacity sufficient to power the operation of the constant current source for at least thirty seconds.

17. An electronic organizer as claimed in claim 15, wherein the constant current source supplies an operational voltage of 1.5 volts at one milliampere to the transmitter/oscillator circuit when the transmitter activation switch is activated.

18. An electronic organizer as claimed in claim 15, wherein the resistor has a value of 20K ohms and the capacitor has a capacitance of 750 microfarads and a charging voltage of 20 volts.

19. An electronic organizer as claimed in claim 15, wherein the main unit is further characterized by an electronic ink-well for recharging the capacitor contained in the power storage network.

20. An electronic organizer as claimed in claim 19, wherein the electronic ink-well includes a recharge well and a storage slot, and wherein the recharge well and the storage slot each include contact electrodes configured to make contact with the contact electrodes of the cordless electronic stylus when the cordless

electronic stylus is inserted into either the recharge well or the storage slot.

21. An electronic organizer as claimed in claim 15, wherein machine generated text data is scanned by the scanning unit to produce scanned text data that is supplied to the control means, and wherein the control means applies an optical character recognition routine to the scanned text data produced by the scanning unit to convert the scanned text data to computer coded text data.

22. An electronic organizer as claimed in claim 15, wherein hand-printed text data is produced by the touch sensitive display unit in response to signals produced by the cordless electronic stylus and is supplied to the control means, and wherein the control means performs an optical character recognition routine on the hand-printed text data to generate computer coded text data.

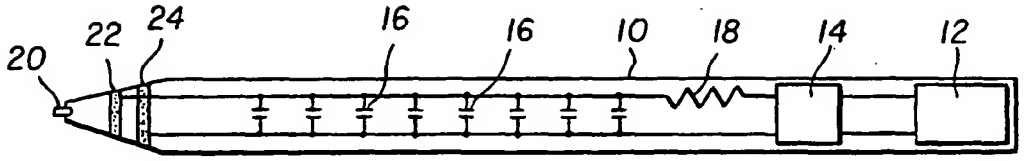
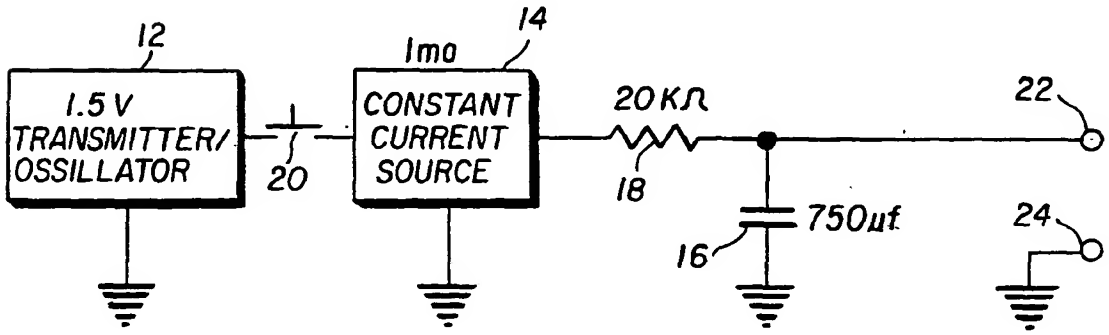


FIG. 1



2XTC = 30 sec. = 1.6V min

FIG. 2

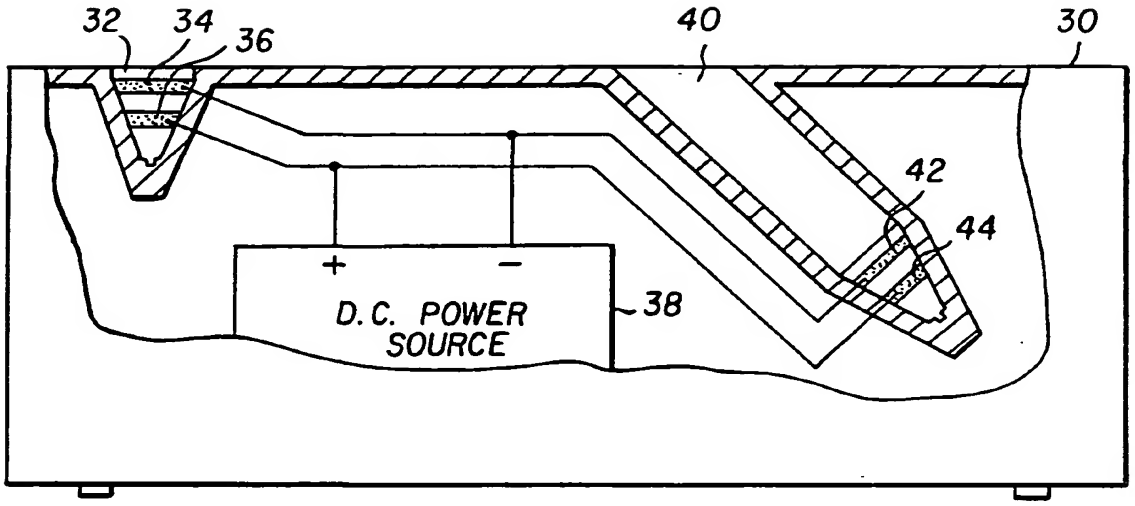

32
34
36
40
30
42
44
+
−
D.C. POWER SOURCE
38

FIG. 3

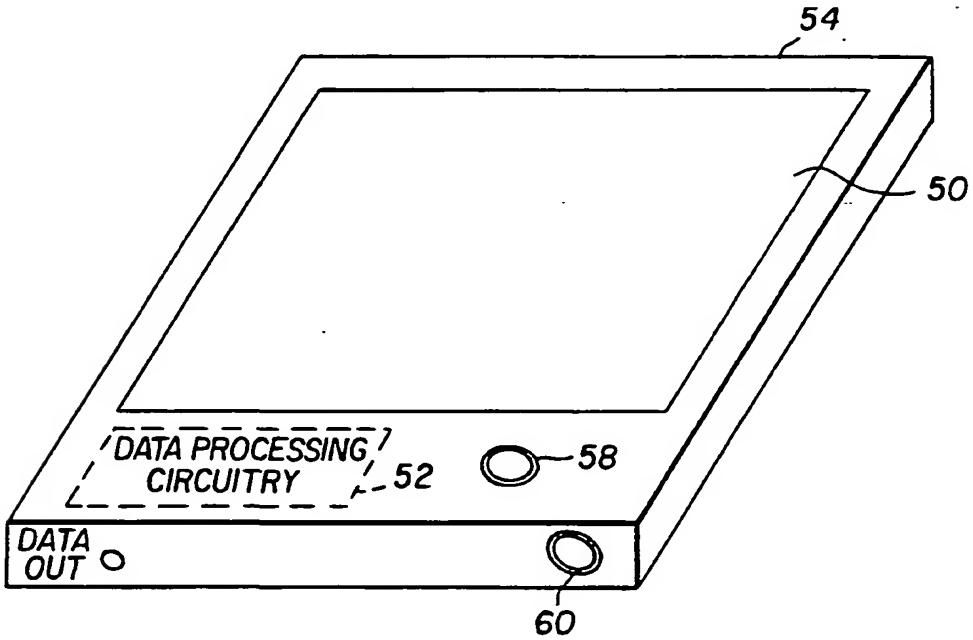

54
50
DATA PROCESSING CIRCUITRY
52
58
DATA OUT
60

FIG. 4

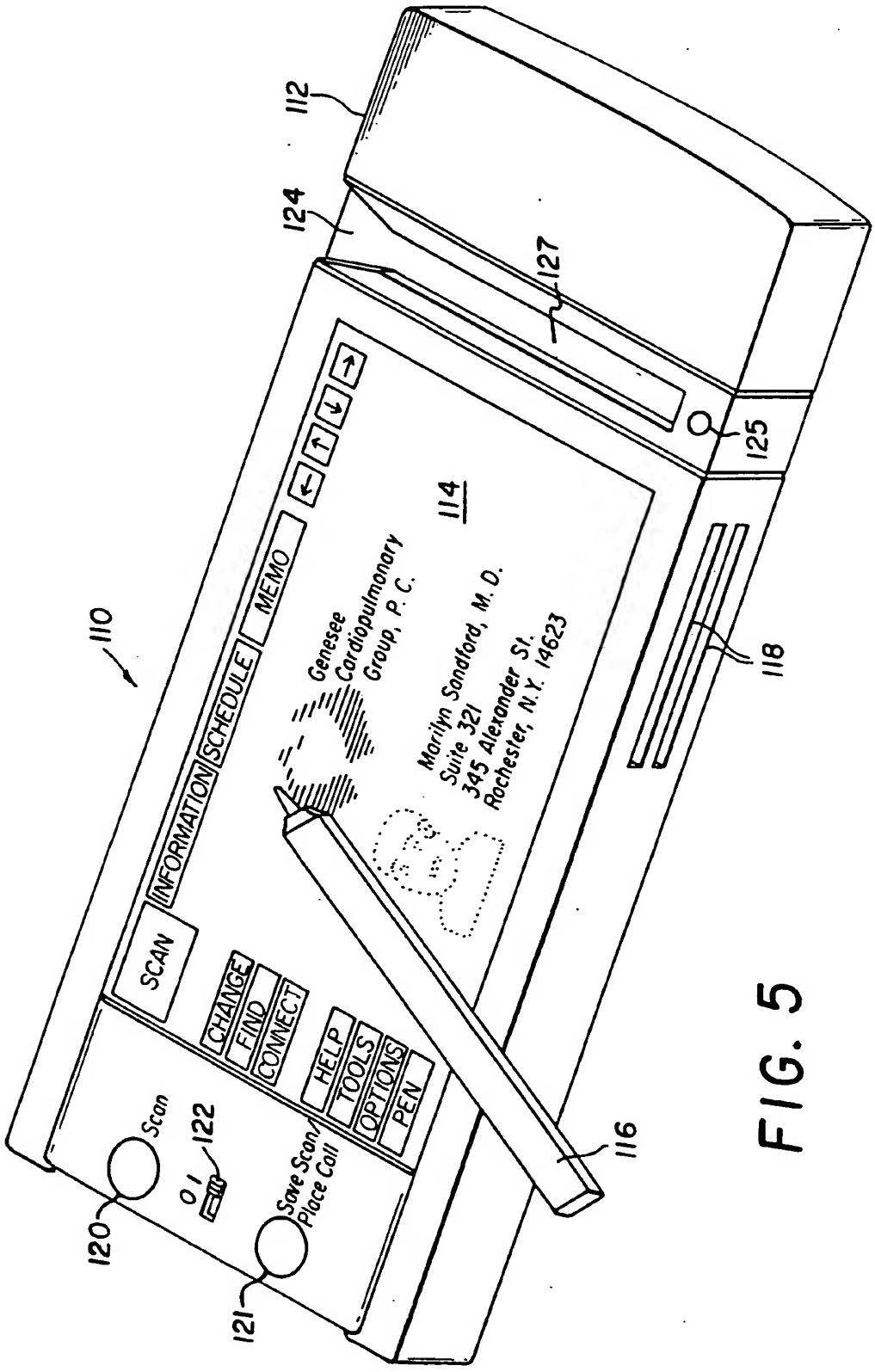

112
124
127
125
110
114
118
INFORMATION
SCHEDULE
MEMO
Genesee Cardiopulmonary Group, P.C.
Marilyn Sandford, M.D.
Suite 321
345 Alexander St.
Rochester, N.Y. 14623
SCAN
CHANGE
FIND
CONNECT
HELP
TOOLS
OPTIONS
PEN
Scan
122
Save Scan/ Place Call
120
121
116

FIG. 5

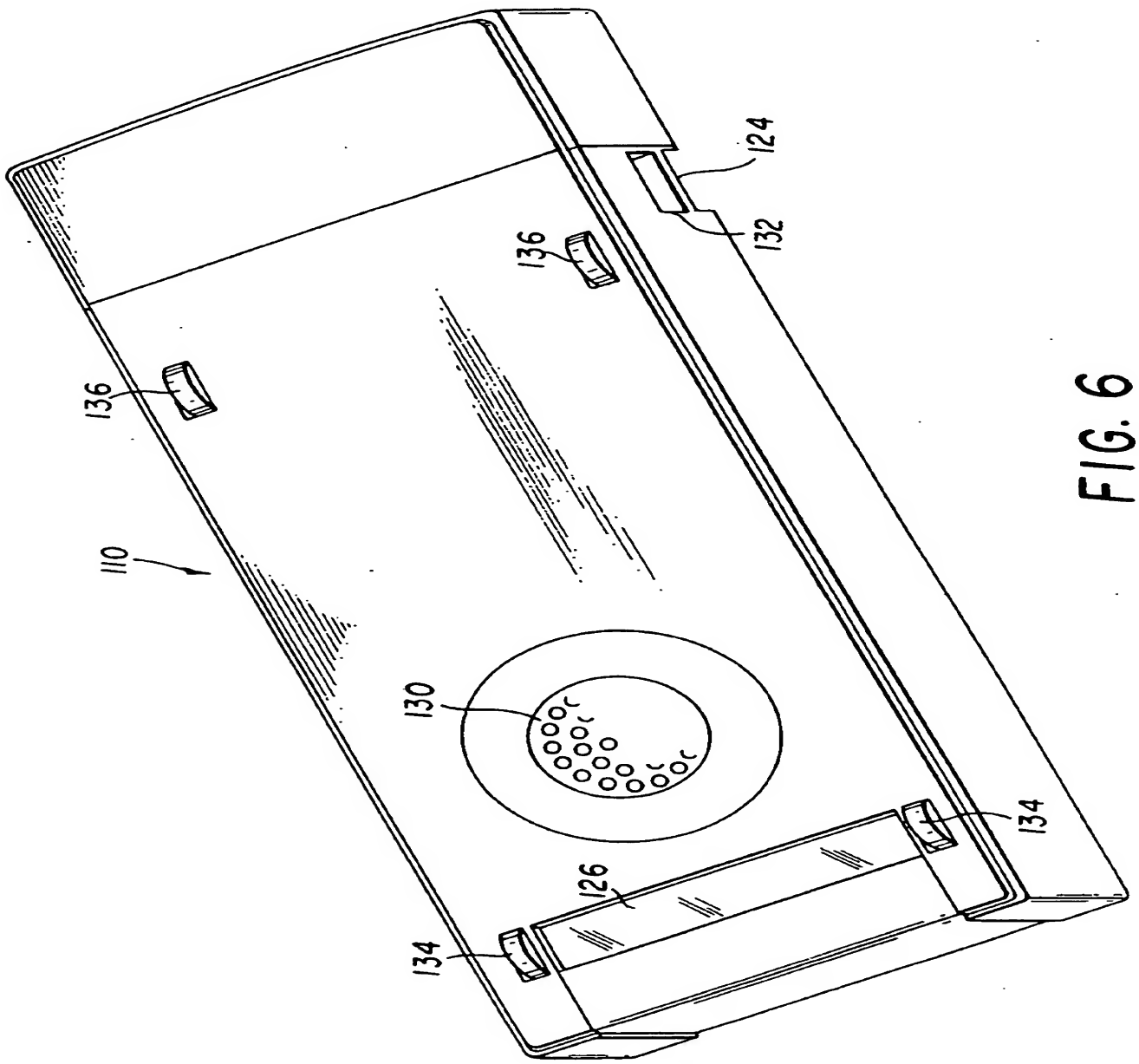


FIG. 6

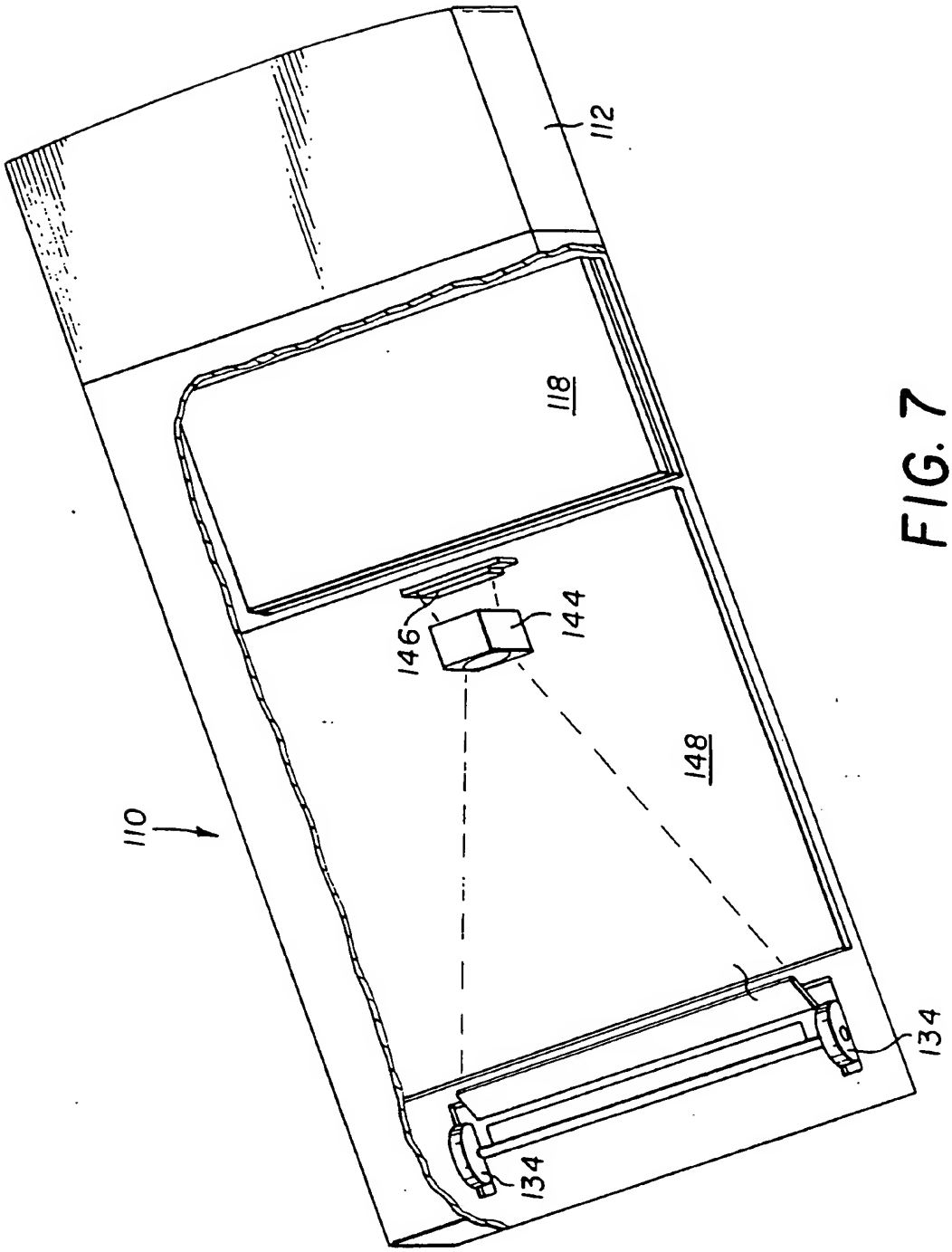


FIG. 7

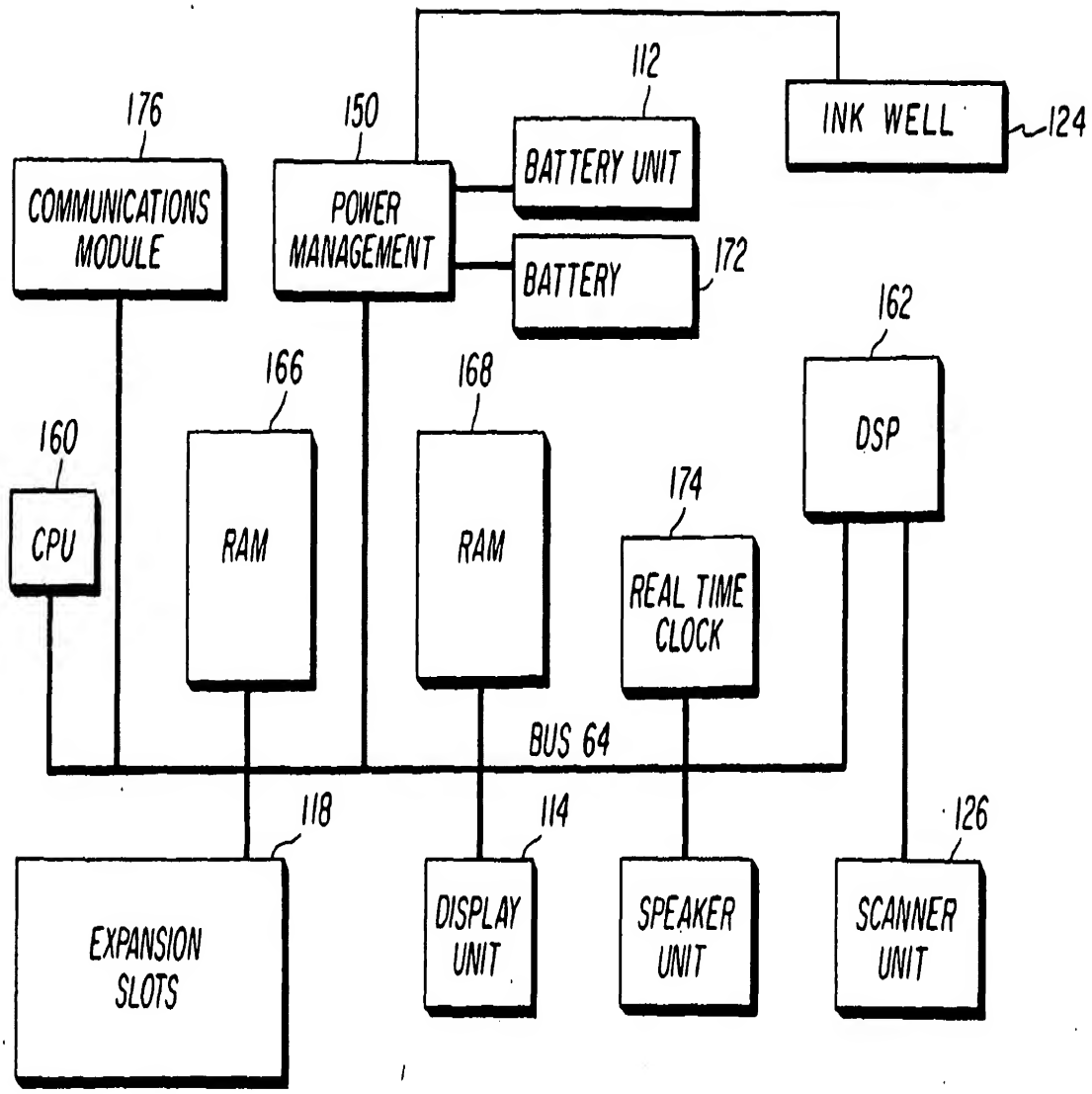
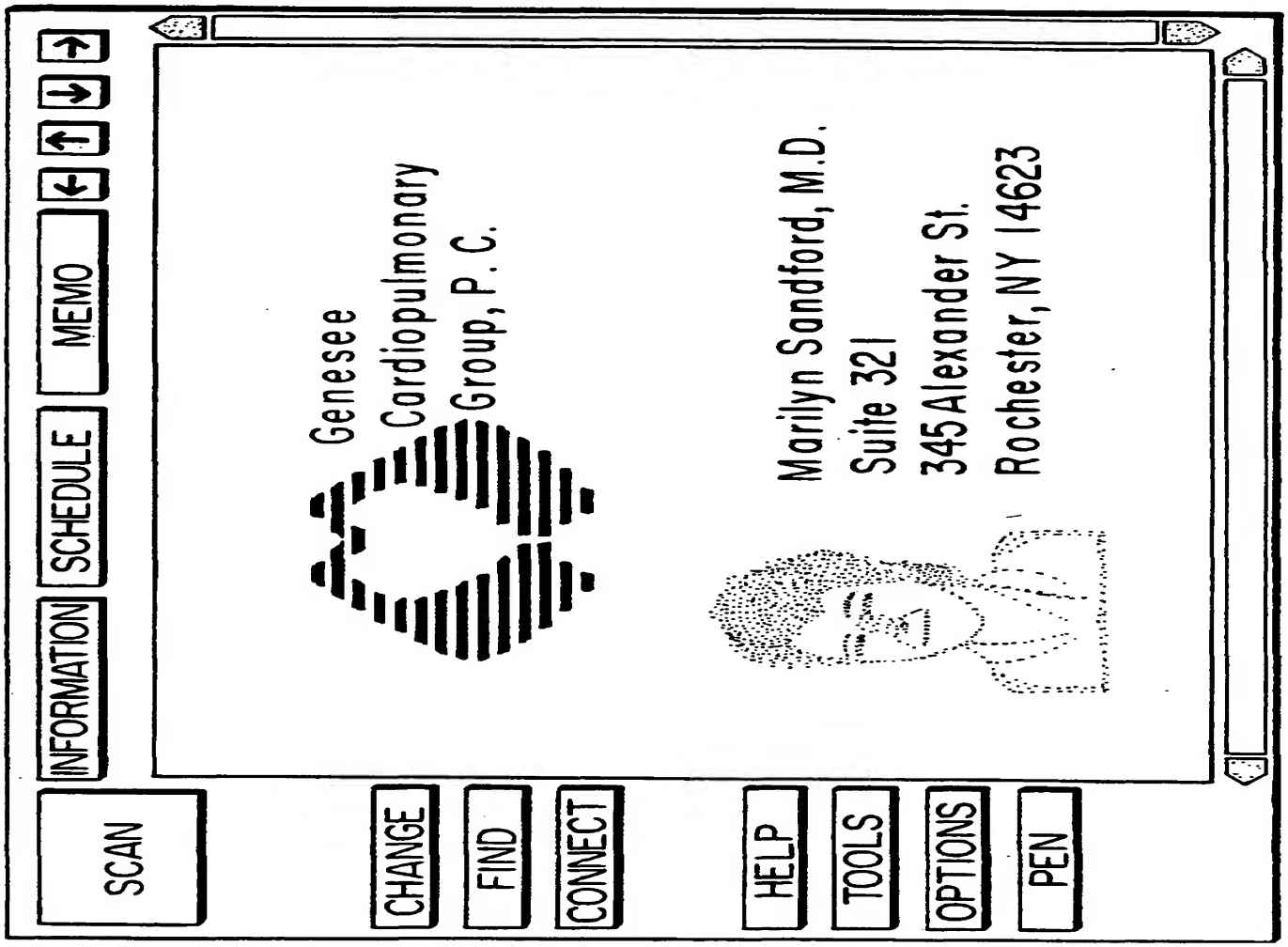

112
176
150
INK WELL
124
BATTERY UNIT
COMMUNICATIONS MODULE
POWER MANAGEMENT
BATTERY
172
162
166
168
DSP
160
CPU
RAM
RAM
174
REAL TIME CLOCK
BUS 64
118
114
126
EXPANSION SLOTS
DISPLAY UNIT
SPEAKER UNIT
SCANNER UNIT

FIG. 8

FIG. 9


SCAN
INFORMATION
SCHEDULE
MEMO
CHANGE
FIND
CONNECT
HELP
TOOLS
OPTIONS
PEN
Genesee
Cardiopulmonary
Group, P. C.
Marilyn Sandford, M.D.
Suite 321
345 Alexander St.
Rochester, NY 14623

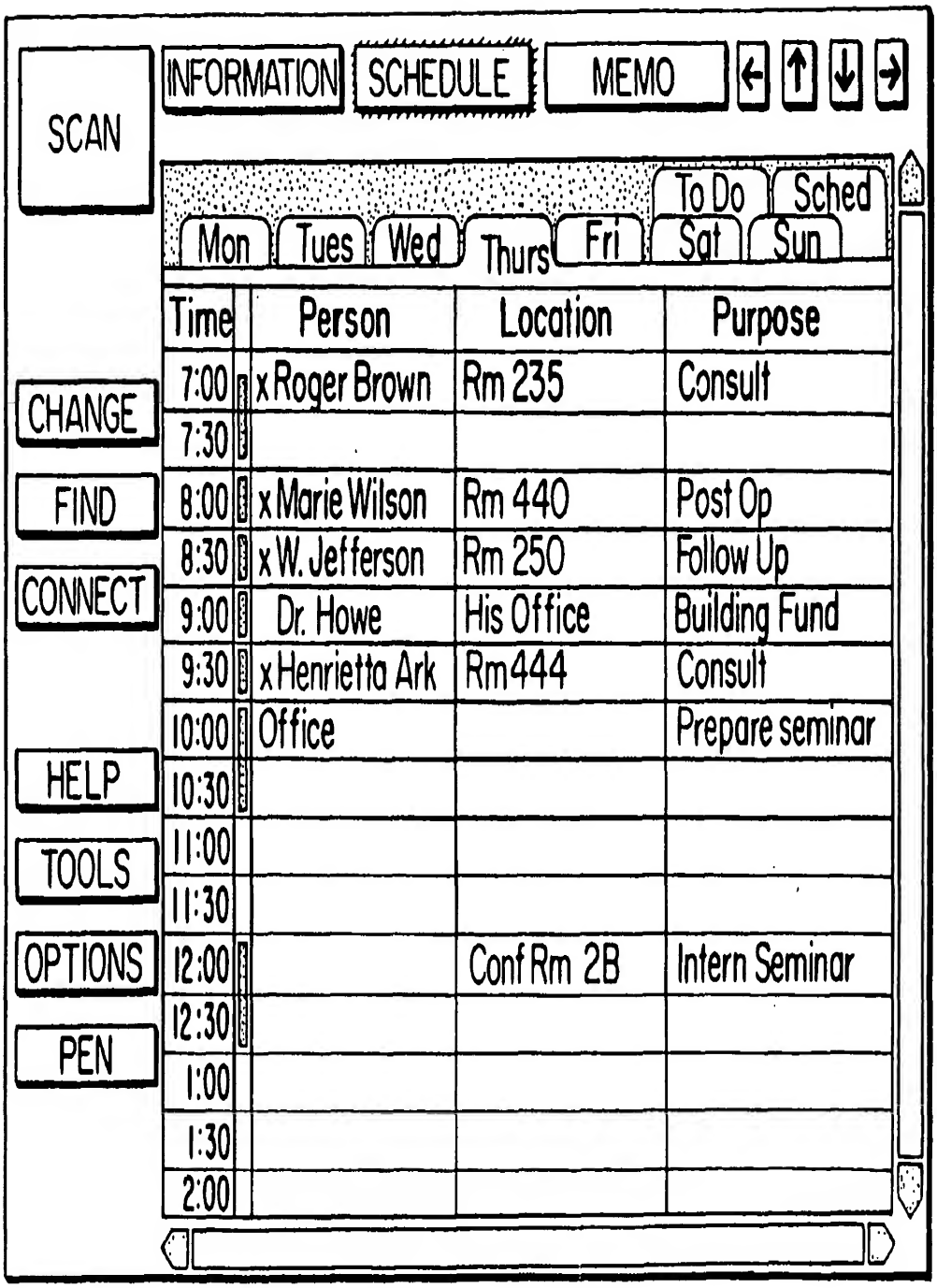

SCAN
INFORMATION
SCHEDULE
MEMO
To Do
Sched
Mon
Tues
Wed
Thurs
Fri
Sat
Sun
Time
Person
Location
Purpose
7:00
x Roger Brown
Rm 235
Consult
7:30
8:00
x Marie Wilson
Rm 440
Post Op
8:30
x W. Jefferson
Rm 250
Follow Up
9:00
Dr. Howe
His Office
Building Fund
9:30
x Henrietta Ark
Rm444
Consult
10:00
Office
Prepare seminar
10:30
11:00
11:30
12:00
Conf Rm 2B
Intern Seminar
12:30
1:00
1:30
2:00
CHANGE
FIND
CONNECT
HELP
TOOLS
OPTIONS
PEN

FIG. 10

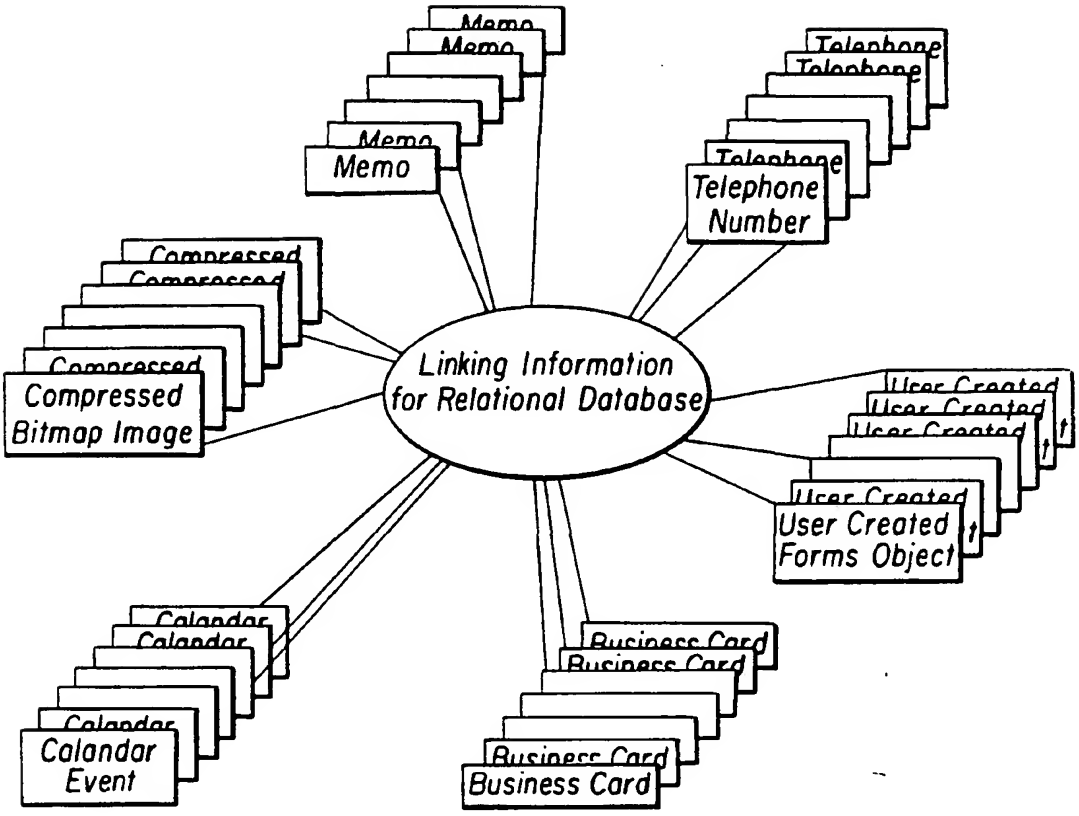

Memo
Telephone Number
Compressed Bitmap Image
Linking Information for Relational Database
User Created Forms Object
Calendar Event
Business Card

FIG. 11

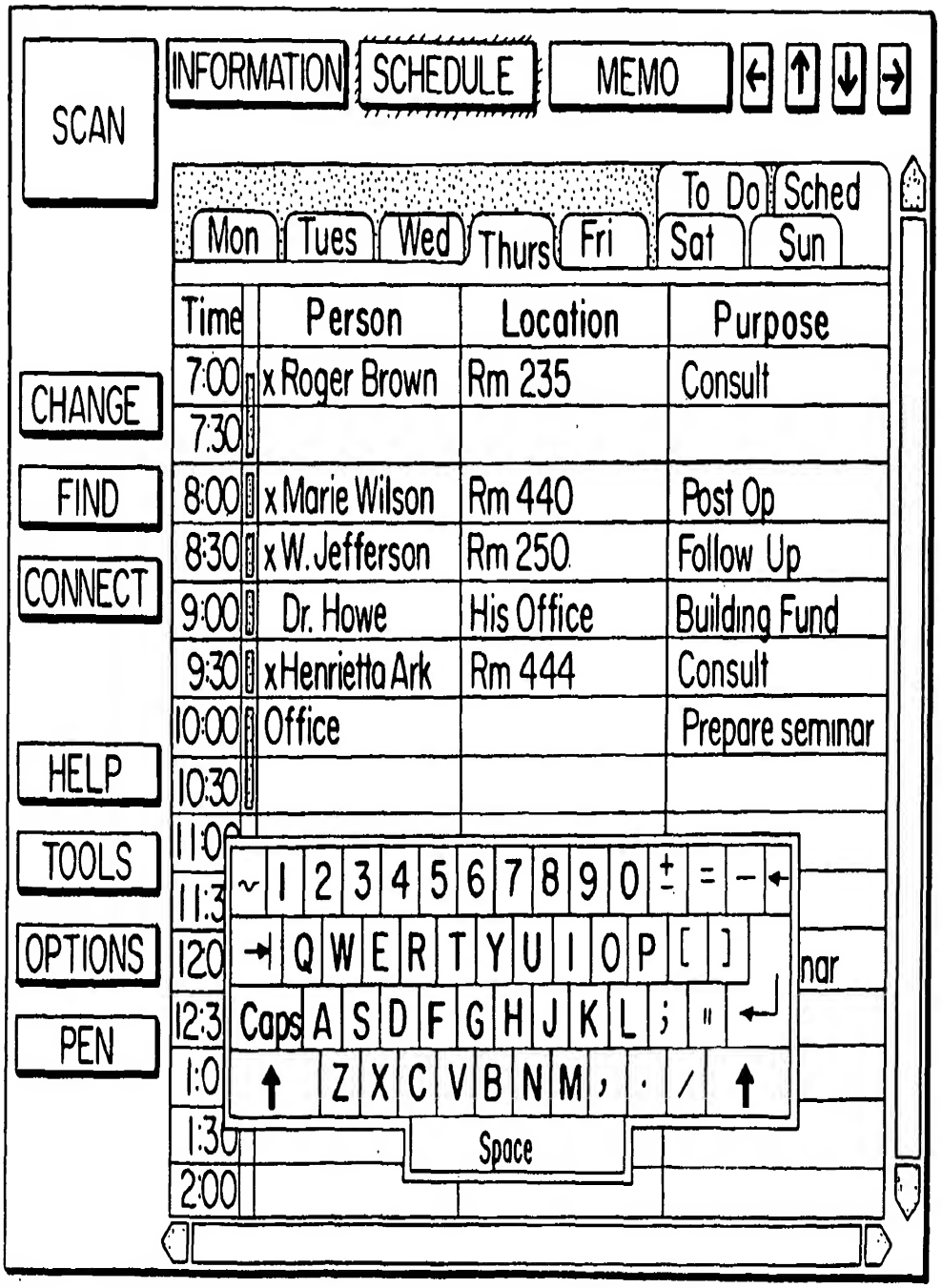
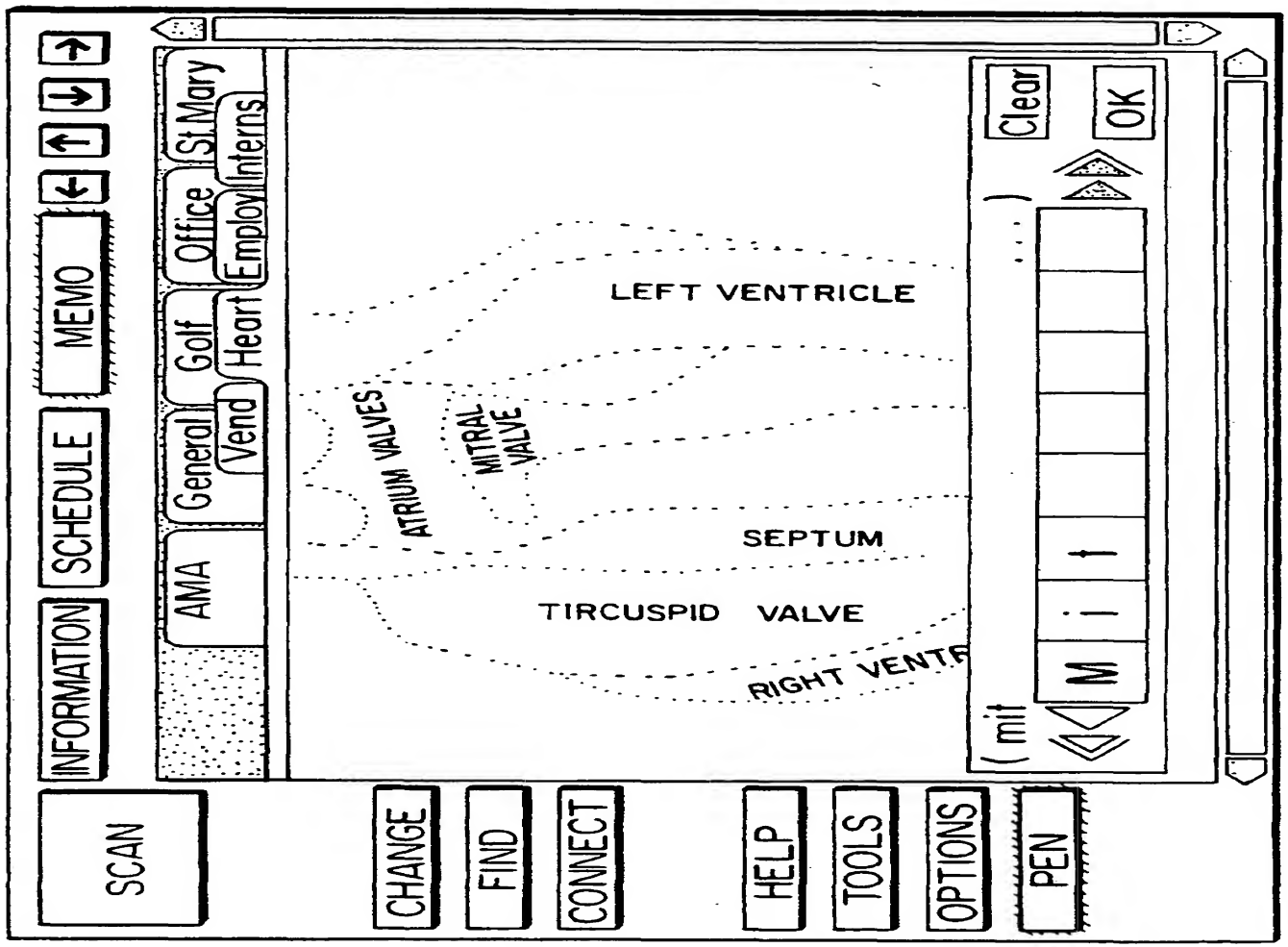

SCAN
INFORMATION
SCHEDULE
MEMO
To Do
Sched
Mon
Tues
Wed
Thurs
Fri
Sat
Sun
Time
Person
Location
Purpose
7:00
x Roger Brown
Rm 235
Consult
7:30
8:00
x Marie Wilson
Rm 440
Post Op
8:30
x W. Jefferson
Rm 250
Follow Up
9:00
Dr. Howe
His Office
Building Fund
9:30
x Henrietta Ark
Rm 444
Consult
10:00
Office
Prepare seminar
10:30
11:0
11:3
12:0
12:3
1:0
1:3
2:00
CHANGE
FIND
CONNECT
HELP
TOOLS
OPTIONS
PEN
Caps
Space

FIG. 12

FIG. 13


SCAN
INFORMATION
SCHEDULE
MEMO
AMA
General
Vend
Golf
Heart
Office
Employ
St.Mary
Interns
CHANGE
FIND
CONNECT
HELP
TOOLS
OPTIONS
PEN
LEFT VENTRICLE
ATRIUM VALVES
MITRAL VALVE
SEPTUM
TIRCUSPID VALVE
RIGHT VENTR
Clear
OK
(mit
M

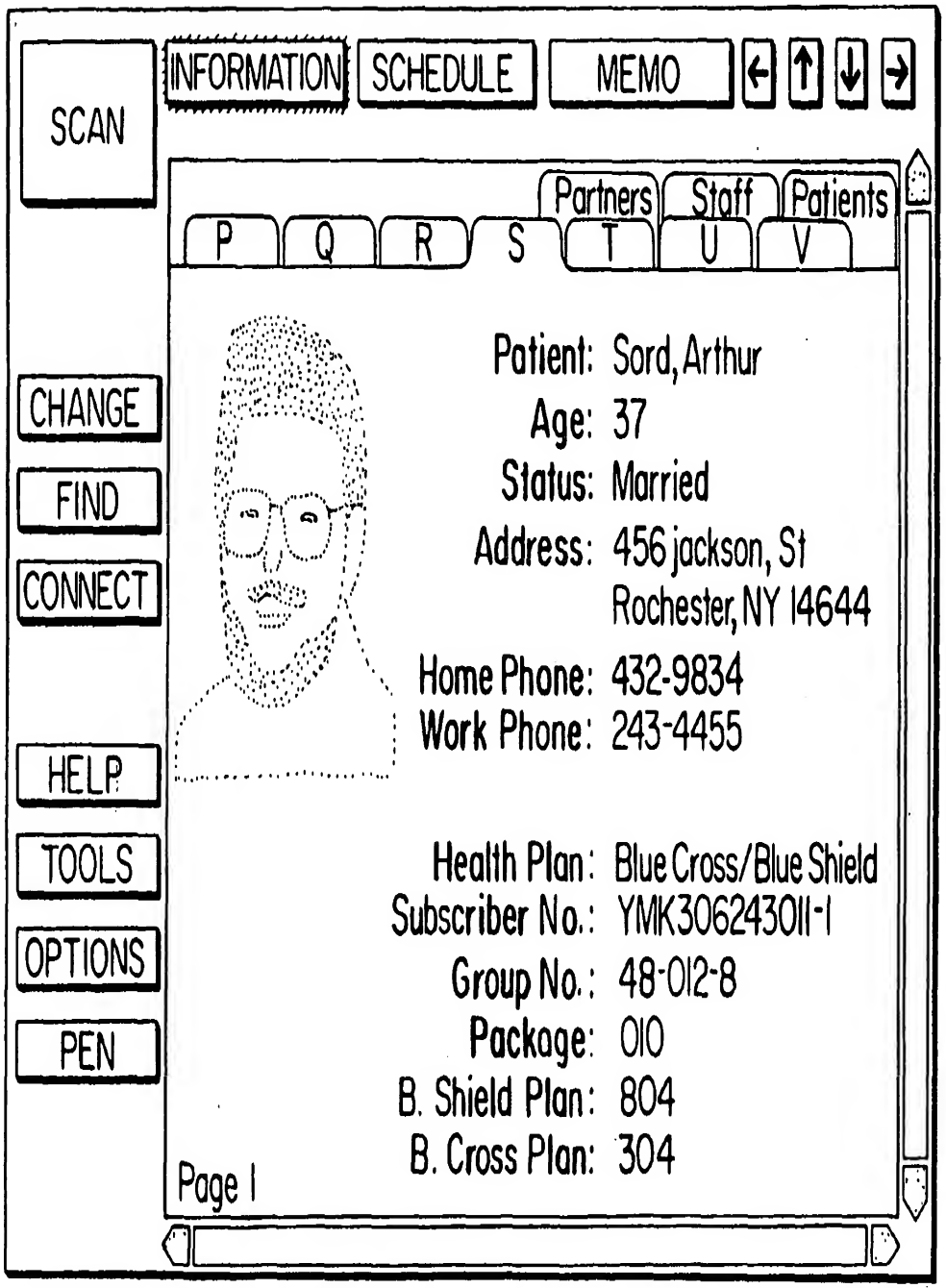

SCAN
INFORMATION
SCHEDULE
MEMO
Partners
Staff
Patients
P
Q
R
S
T
U
V
CHANGE
FIND
CONNECT
HELP
TOOLS
OPTIONS
PEN
Patient: Sord, Arthur
Age: 37
Status: Married
Address: 456 jackson, St
Rochester, NY 14644
Home Phone: 432-9834
Work Phone: 243-4455
Health Plan: Blue Cross/Blue Shield
Subscriber No.: YMK30624301I-1
Group No.: 48-012-8
Package: 010
B. Shield Plan: 804
B. Cross Plan: 304
Page 1

FIG. 14

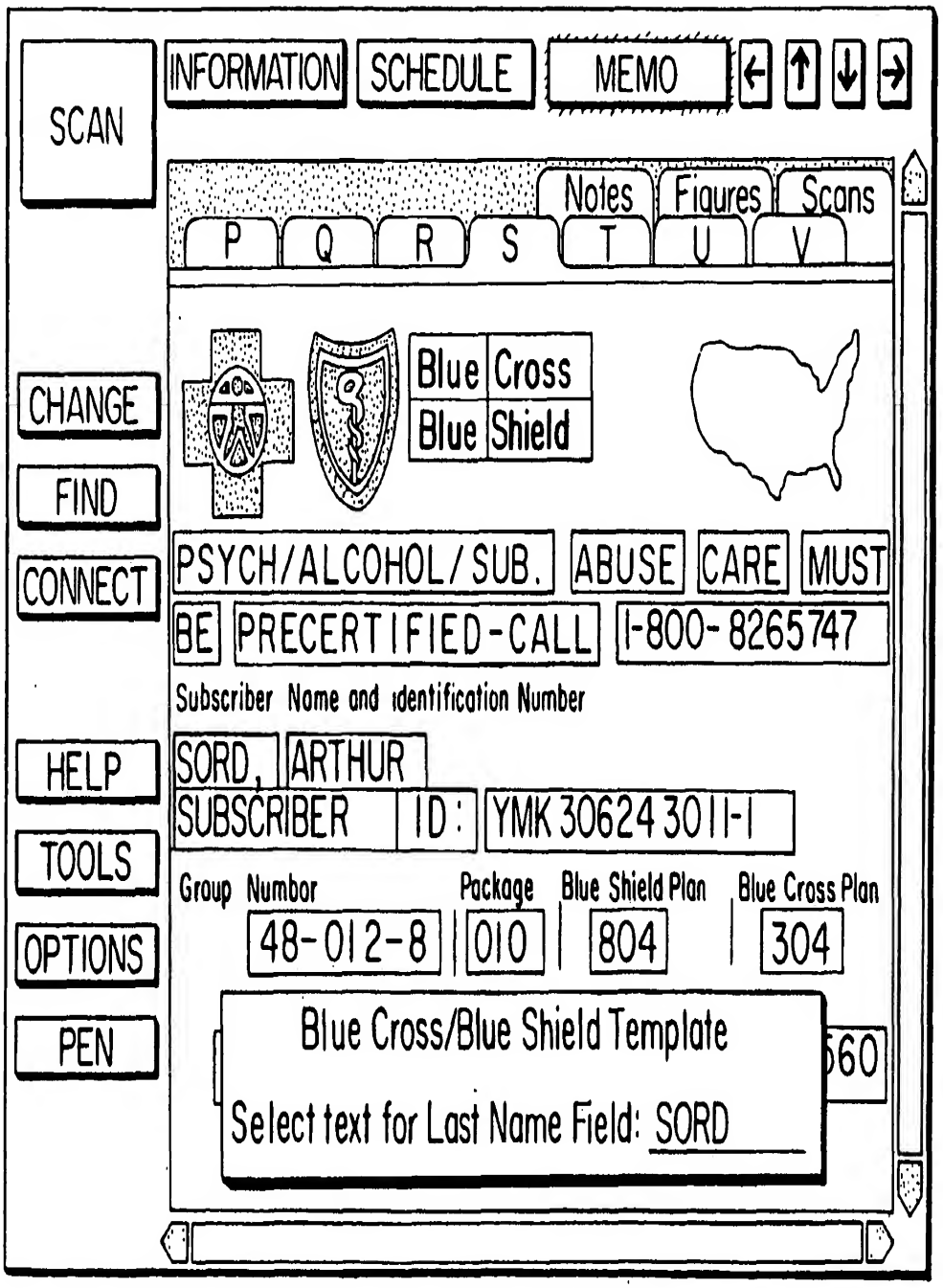

SCAN
INFORMATION
SCHEDULE
MEMO
Notes
Figures
Scans
P
Q
R
S
T
U
V
Blue Cross
Blue Shield
CHANGE
FIND
CONNECT
PSYCH/ALCOHOL/SUB.
ABUSE
CARE
MUST
BE
PRECERTIFIED-CALL
1-800-8265747
Subscriber Name and identification Number
SORD,
ARTHUR
SUBSCRIBER
ID:
YMK 30624 3011-1
HELP
TOOLS
OPTIONS
PEN
Group Number
Package
Blue Shield Plan
Blue Cross Plan
48-012-8
010
804
304
Blue Cross/Blue Shield Template
Select text for Last Name Field: SORD

FIG. 15

FIG. 16

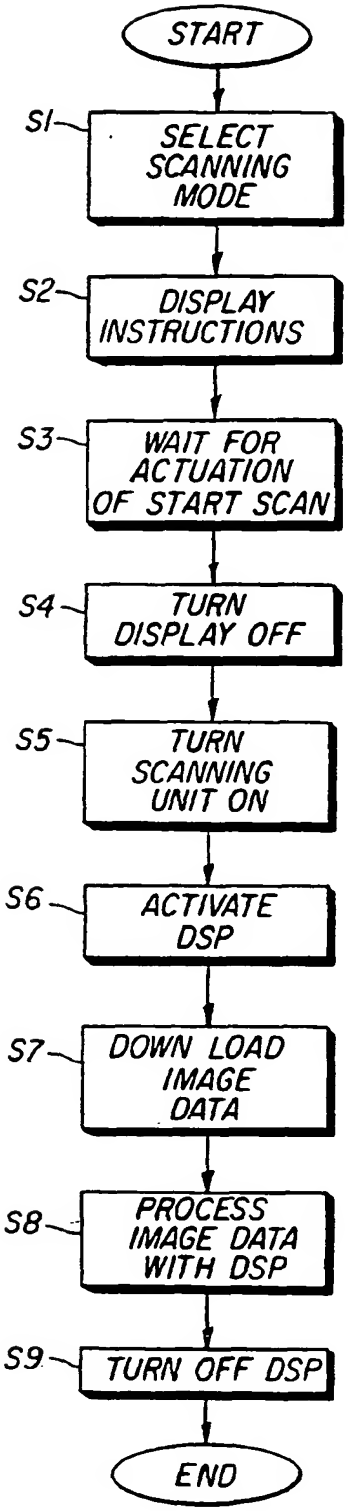
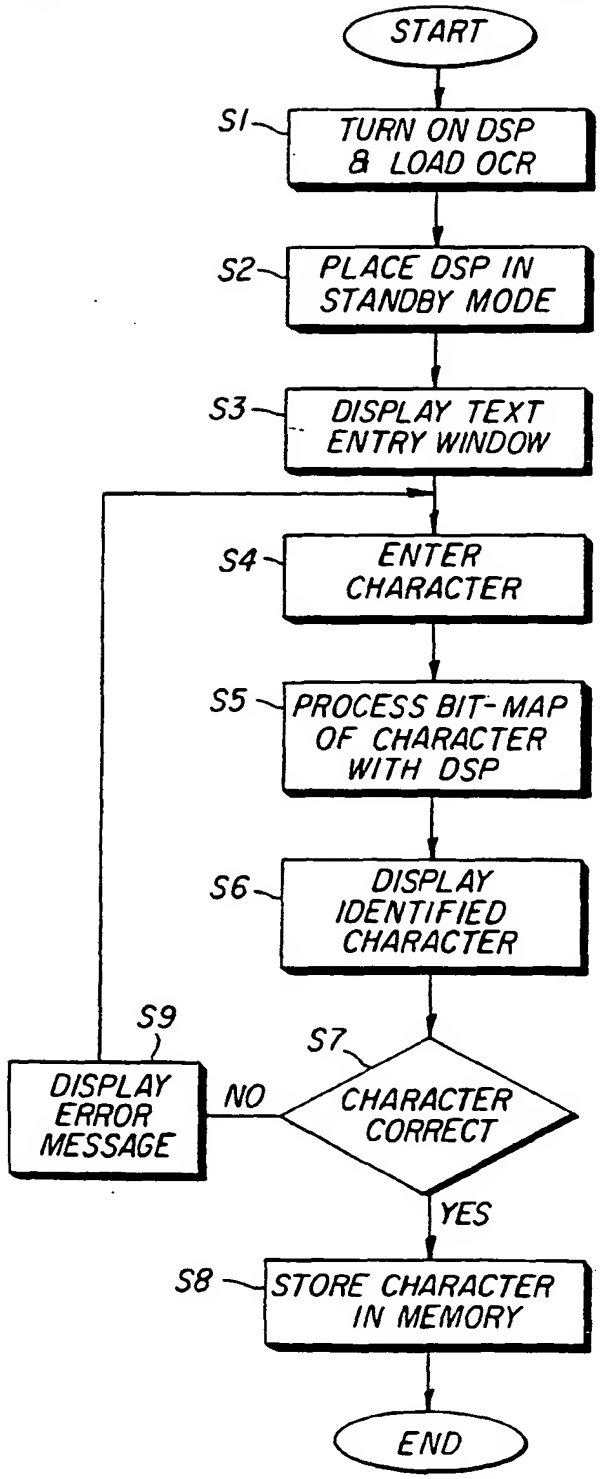

START
S1
SELECT SCANNING MODE
S2
DISPLAY INSTRUCTIONS
S3
WAIT FOR ACTUATION OF START SCAN
S4
TURN DISPLAY OFF
S5
TURN SCANNING UNIT ON
S6
ACTIVATE DSP
S7
DOWN LOAD IMAGE DATA
S8
PROCESS IMAGE DATA WITH DSP
S9
TURN OFF DSP
END

FIG. 17


START
S1
TURN ON DSP & LOAD OCR
S2
PLACE DSP IN STANDBY MODE
S3
DISPLAY TEXT ENTRY WINDOW
S4
ENTER CHARACTER
S5
PROCESS BIT-MAP OF CHARACTER WITH DSP
S6
DISPLAY IDENTIFIED CHARACTER
S7
CHARACTER CORRECT
NO
S9
DISPLAY ERROR MESSAGE
YES
S8
STORE CHARACTER IN MEMORY
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 93/02778

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: G06K 11/18
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: G06K, G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP, A2, 0435511 (SONY CORPORATION), 3 July 1991 (03.07.91) --	1-22
A	US, A, 4672154 (JAMES L. RODGERS ET AL), 9 June 1987 (09.06.87) --	1-14
A	DE, A1, 3040364 (LICENTIA PATENT-VERWALTUNGS-GMBH), 27 May 1982 (27.05.82) --	1-14
A	DE, B2, 2352931 (SIEMENS AG), 12 February 1976 (12.02.76) --	1-7,14

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 June 1993	26. 07. 93
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Jan Silfverling

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 93/02778

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE, A1, 4111710 (DIGITAL STREAM CORP), 22 October 1992 (22.10.92) --	1-14
A	Patent Abstracts of Japan, Vol 11,No 216, P-595, abstract of JP, A, 62-34225 (FUJITSU LTD), 14 February 1987 (14.02.87) --	1-7,14
A	US, A, 4883926 (RICHARD R. BALDWIN), 28 November 1989 (28.11.89) --	1-7,14

SA 2236

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/05/93

International application No.
PCT/US 93/02778

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0435511	03/07/91	JP-A- 3201016	02/09/91
		US-A- 5067573	26/11/91
US-A- 4672154	09/06/87	JP-C- 1707438	27/10/92
		JP-B- 3068411	28/10/91
		JP-A- 61292733	23/12/86
		US-A- 4748295	31/05/88
DE-A1- 3040364	27/05/82	NONE	
DE-B2- 2352931	12/02/76	BE-A- 821340	22/04/75
		FR-A,B- 2248558	16/05/75
		GB-A- 1471231	21/04/77
		NL-A- 7413609	24/04/75
DE-A1- 4111710	22/10/92	US-A- 5166668	24/11/92
US-A- 4883926	28/11/89	EP-A- 0344897	06/12/89
		JP-A- 1312620	18/12/89